Automating Cataloging and Discovery of Services for Service-Oriented Robotic Systems

Lucas Bueno Ruas de Oliveira, Diogo Martins, Felipe Amaral, Flavio Oquendo, Elisa Yumi Nakagawa

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Agenda

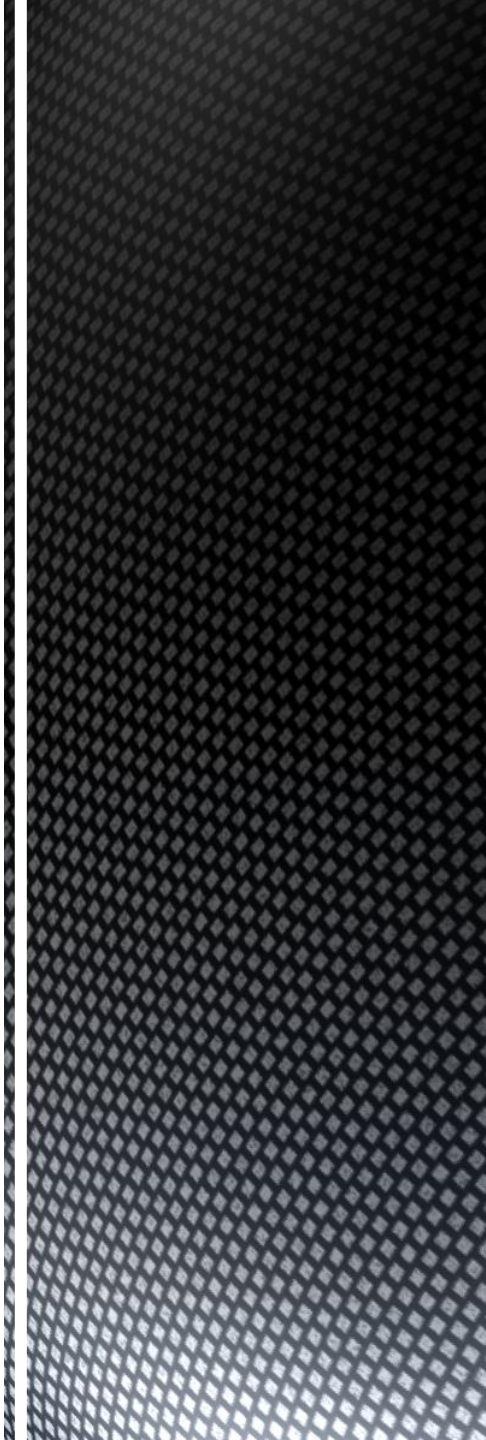
Introduction

Developing RoboSeT

Case Study

Discussion

Conclusion and Future Work

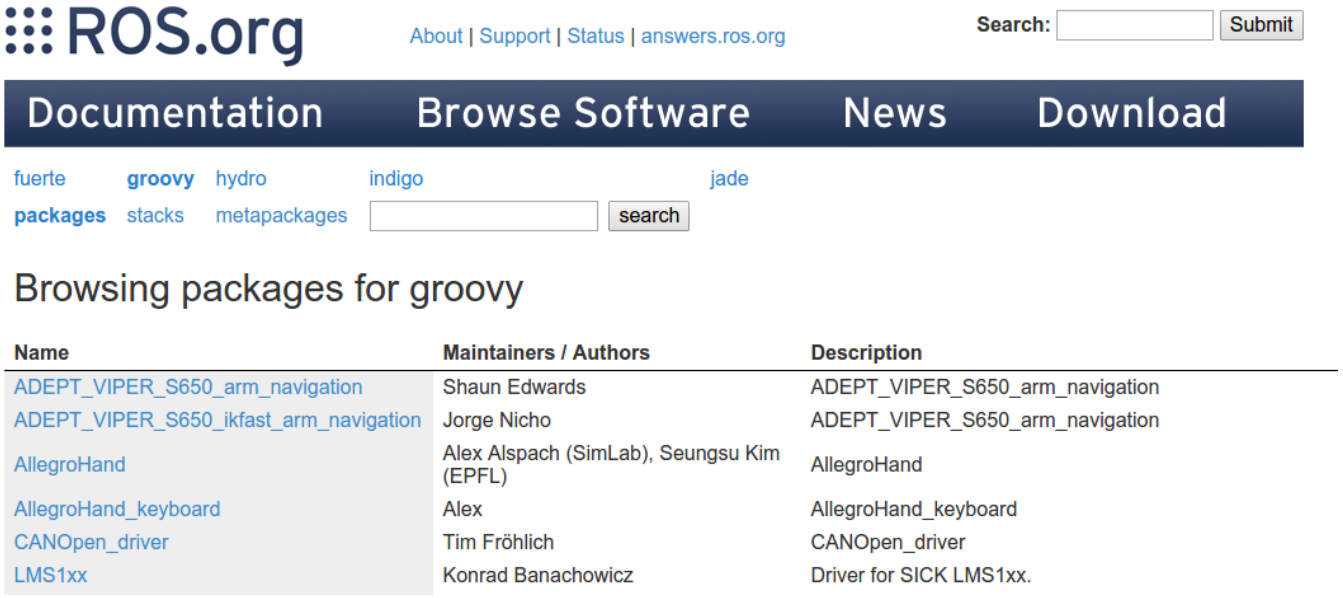


Introduction

- Robots have been used in several areas of the society
- Complexity and diversity challenge the development of robotic systems
- Service-Oriented Architecture (SOA) promotes better reusability and flexibility to robotic systems
- Several Service-Oriented Robotic Systems (SORS) can be found in the literature
- Development environments for SORS are also available

Introduction

- Motivation:
  - SORS development environments do not provide facilities for location and selection of services



Introduction

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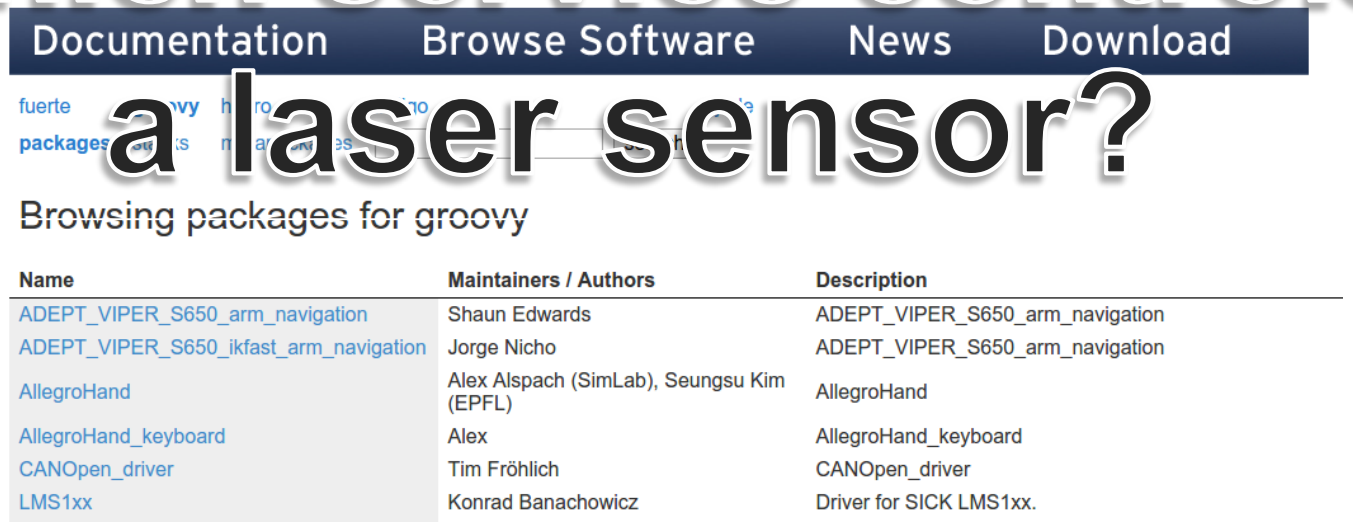
Which service controls a laser sensor?



Name	Maintainers / Authors	Description
ADEPT_VIPER_S650_arm_navigation	Shaun Edwards	ADEPT_VIPER_S650_arm_navigation
ADEPT_VIPER_S650_ikfast_arm_navigation	Jorge Nicho	ADEPT_VIPER_S650_arm_navigation
AllegroHand	Alex Alspach (SimLab), Seungsu Kim (EPFL)	AllegroHand
AllegroHand_keyboard	Alex	AllegroHand_keyboard
CANOpen_driver	Tim Fröhlich	CANOpen_driver
LMS1xx	Konrad Banachowicz	Driver for SICK LMS1xx.

Introduction

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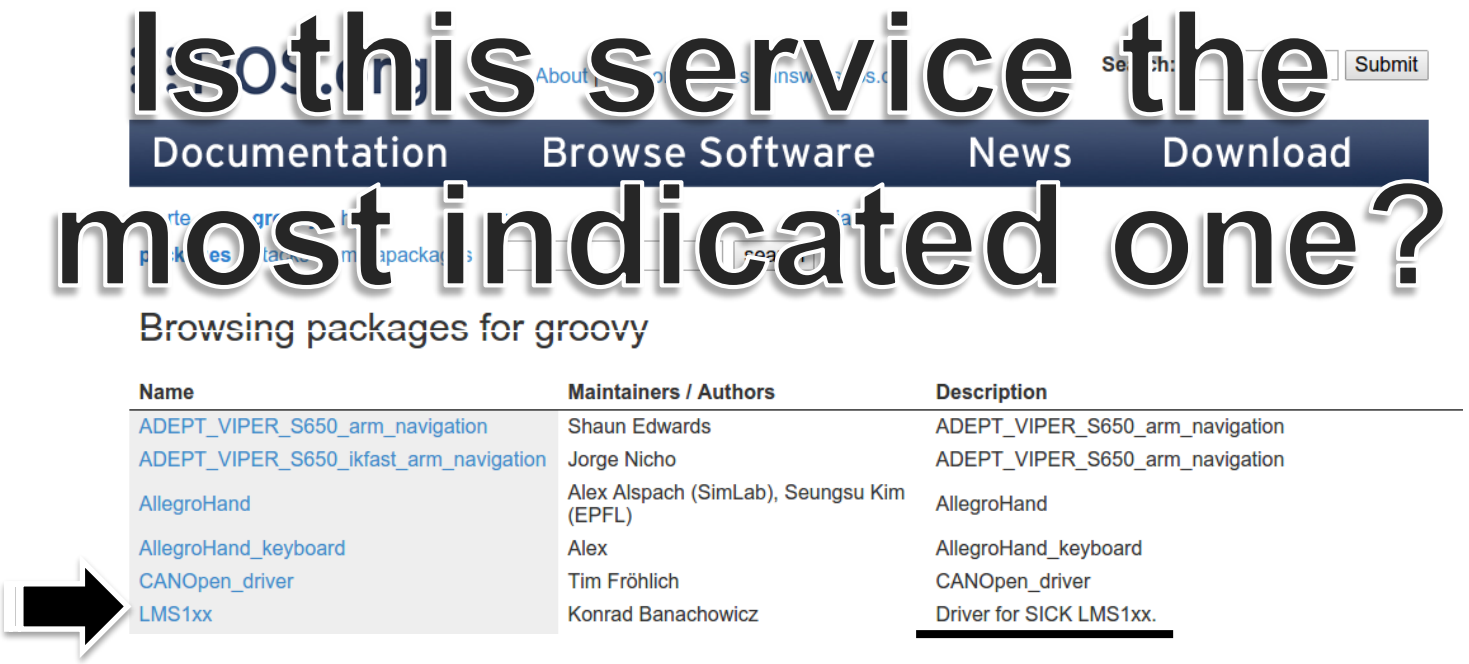
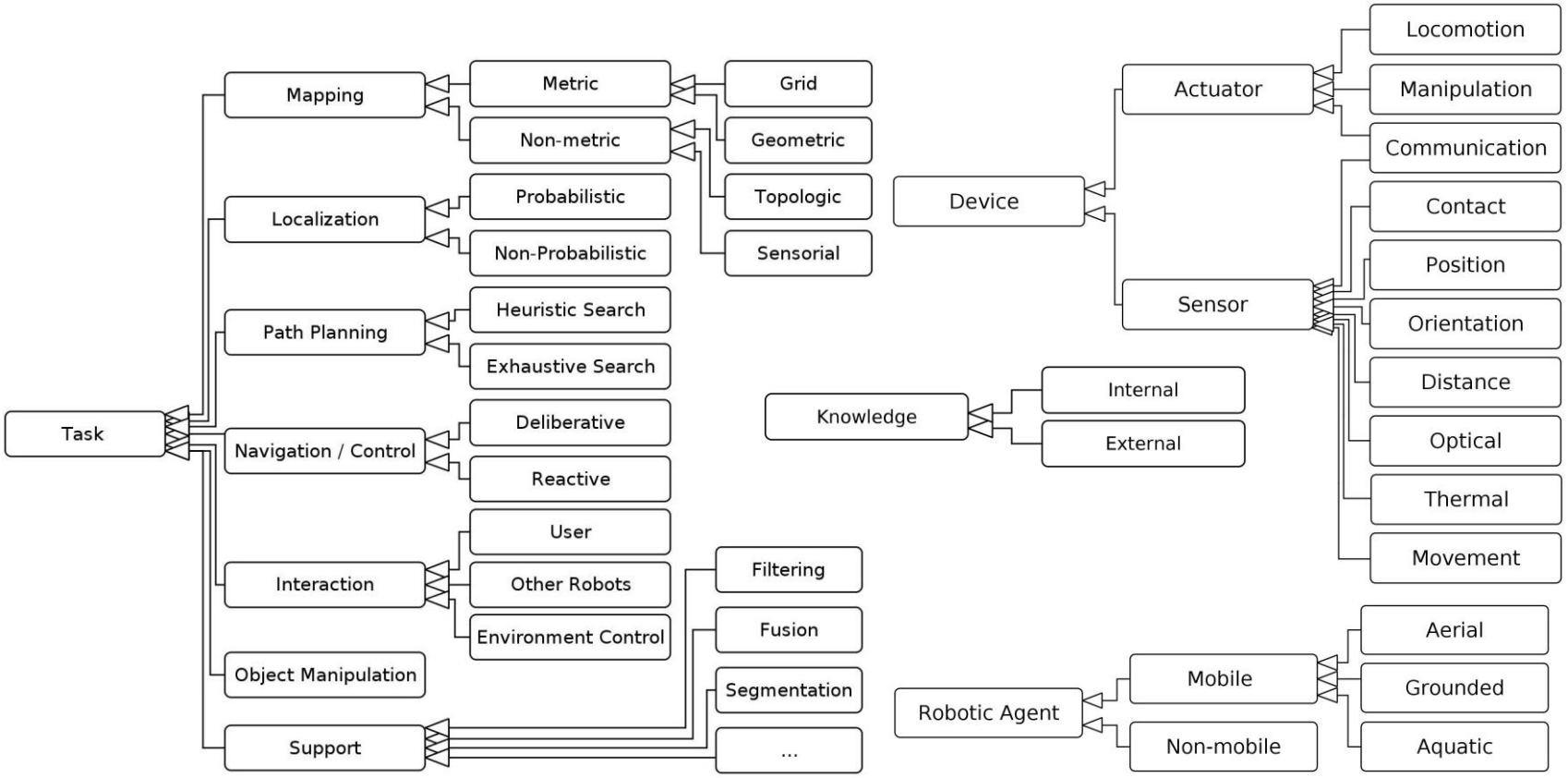


Introduction

- Main goal:
  - To present RoboSeT (Robotics Services Semantic Search Tool), a mechanism that supports cataloging and discovery of services for robotic systems using semantic information.

Developing RoboSeT

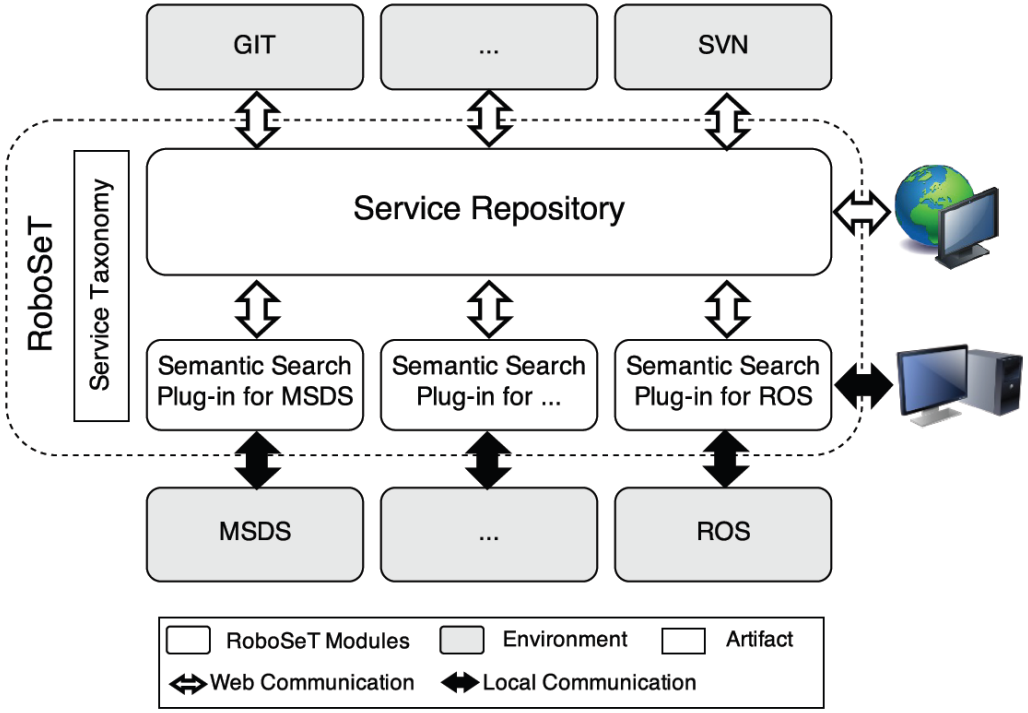
- First step: Establishment of a common vocabulary [1]



[1] Oliveira, L. B. R.; Osório, F. S.; Oquendo, F.; Nakagawa, E. Y.; Towards a Taxonomy of Services for Developing Service-Oriented Robotic Systems. In: *SEKE'14,* 2014, Vancouver, Canada, p. 344-349.

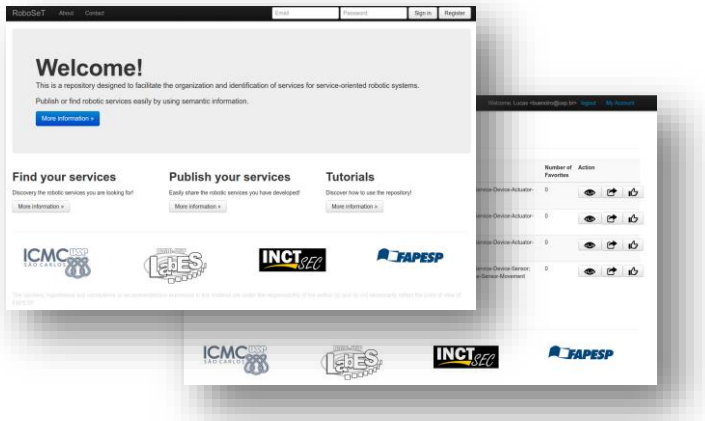
Developing RoboSeT

- RoboSeT is divided into two main subsystems:
  - Service repository (Web Interface)
  - Service plug-ins (GUI or command line)

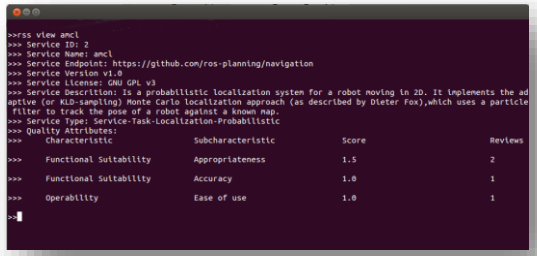


Developing RoboSeT

- Service repository:
  - Account management
  - Service publication
  - Service search and detailing
  - Service management
  - News about services



- Plug-ins:
  - Service search
  - Service identification
  - Service obtaining and deployment
  - Feedback about services (quality, bugs, comments)



Case study

- Design of a robotic system for robust navigation
  - Motion Planning
  - Trajectory generation
  - Obstacle detection and representation
  - Obstacle avoidance
  - Position and velocity control
  - Localization
  - Laser controller
  - Pioneer P3-DX controller

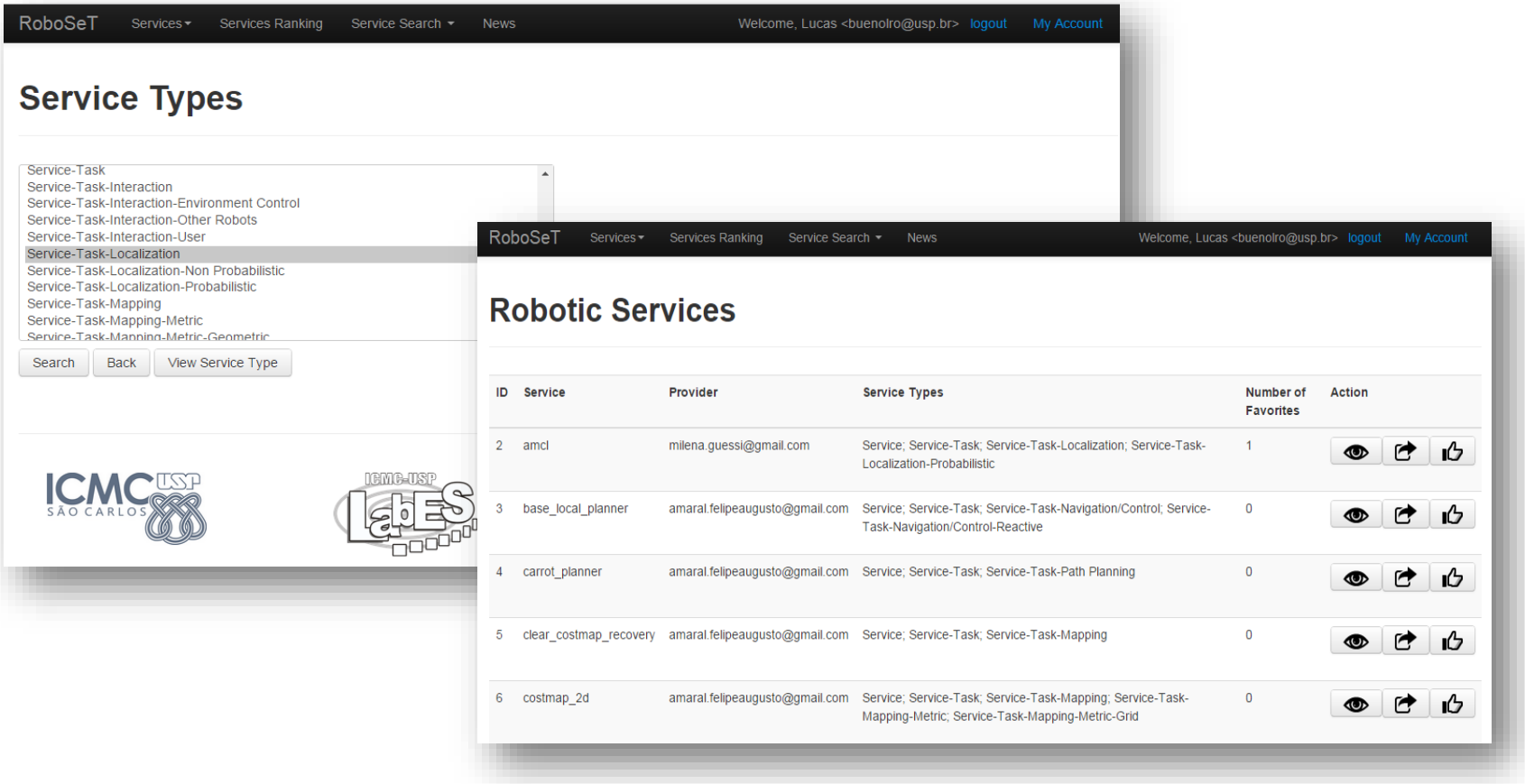
Case study

- Mapping requirements into service types

Functionality	Service type
Motion Planning	Service/Task/Path planning
Trajectory generation	Service/Task/Path planning
Obstacle detection and representation	Service/Task/Mapping
Obstacle avoidance	Service/Task/Path planning
Position and velocity control	Service/Task/Navigation
Localization	Service/Task/Localization
Encoder controller	Service/Device/Sensor/Movement
Differential drive controller	Service/Device/Actuator/Locomotion
Laser controller	Service/Device/Sensor/Distance

Case study

- Searching for ROS services



Case study

- Searching for ROS services (Part I)

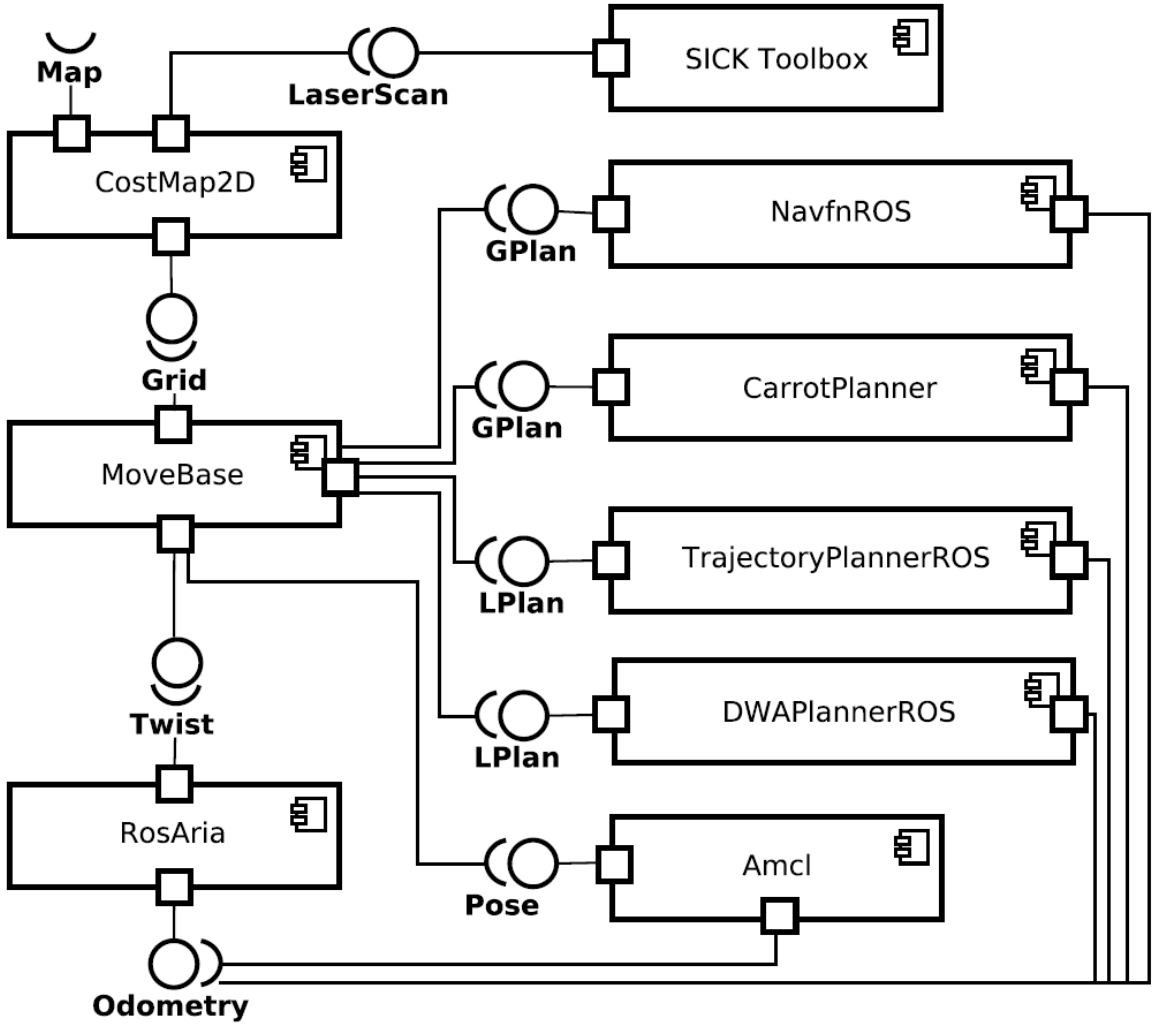
Functionality	Task service type	ROS Service
Motion Planning	Path planning/Heuristic Search	NavfnROS, CarrotPlanner
Trajectory generation	Path planning/Heuristic Search	TrajectoryPlannerROS, DWAPlannerROS
Obstacle detection and representation	Mapping/Metric/Grid	CostMap2D
Obstacle avoidance	Path planning/Heuristic Search	TrajectoryPlannerROS, DWAPlannerROS
Position and velocity control	Navigation	MoveBase
Localization	Localization/Probabilistic	Amcl

Case study

- Searching for ROS services (Part II)

Functionality	Device service type	ROS Service
Encoder controller	Sensor/Movement	RosAria
Differential drive controller	Actuator/Locomotion	RosAria
Laser controller	Sensor/Distance	SICK Toolbox

Case study


Map
LaserScan
SICK Toolbox
CostMap2D
GPlan
NavfnROS
Grid
GPlan
CarrotPlanner
MoveBase
LPlan
TrajectoryPlannerROS
Twist
LPlan
DWAPlannerROS
RosAria
Pose
Amcl
Odometry

Discussion

- Advantages:
  - Services can be transparently shared and discovered
  - Services that are easier to be found are more likely to be reused
  - Structured information can support identification of more suitable services
  - Reuse improvements positively influence productivity in software systems development
  - Community feedback can guide the development of services of better quality

Discussion

- Main limitation:
  - RoboSeT is depended on community adoption and cooperation
- Current initiatives to mitigate such limitation:
  - To promote RoboSeT in the robotics community
  - To release an open source version of RoboSeT

Conclusion and Future Work

- SOA is a promising architectural style for robotics
- A mechanism for supporting cataloging, publishing, and discovery of services can contribute to the SORS development
- Results indicate that RoboSeT can ease the discovery of services for SORS
- Future work:
  - To perform an experiment
  - To develop new functionalities and plug-ins

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